I. C. 7115

May 1940

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, ACTING DIRECTOR

INFORMATION CIRCULAR

CARS FOR TRANSPORTING EXPLOSIVES

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BY

C. W. OWINGS

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

CARS FOR TRANSPORTING EXPLOSIVES[1]

By C. W. Owings[2]

INTRODUCTION

The handling and transportation of explosives and explosives supplies are inherently hazardous owing to their sensitiveness to impact and flame or electric arcs and sparks. Many accidents have occurred in the past during transportation of explosives, especially when they were carried by individual miners on man-trips. When electric haulage became the usual mode of transportation and shots were fired electrically, the hazards of carrying explosives and supplies on man-trips were fully realized, and in some mines all explosives were placed in one car, usually at the rear of the trip. Far-sighted managers saw the danger of this practice and provided separate trips for delivering explosives. This step was a definite advance in safety, but the latest achievement is the construction of special, rugged, non-conducting cars.

Many coal-mining men have shown considerable interest in the construction of safe cars for explosives during recent months. Undoubtedly many others are interested in this phase of safety, therefore this circular is issued to give information on cars of this type now in use.

EXPLOSIVES CAR A

Car A (fig. 1) is essentially a closed inner box separated from an outer box by an insulating lining of rubber. The double box is attached to a standard steel chassis that has spring journals and electric welding instead of certain rivets. The chassis is equipped with roller bearings. The over-all length from pin to pin is 11 feet, 9 inches; the wheel base is 54 inches, the track gage 42 inches, and the capacity eighteen 50-pound cases of permissible explosives. The box is 10 feet long, 6 feet wide, 3 feet high at the top of the arched roof, and 2 feet 9 inches at the edges. The top of the car is 46 inches above the top of the rail.

The inner box is insulated from the outer box by two pieces of 1/4-inch switchboard-insulating matting cemented together. To cover the top, two ends, two sides, and the bottom of the box requires 320 square feet of the 1/4-inch matting.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7115."

[2] Mining engineer, Safety Division, Bureau of Mines, Pittsburgh, Pa.

The walls are well-seasoned tongue-and-groove oak, 1 1/4 inches thick and 2 3/4 inches wide. A 1 1/4-inch air space is maintained by oak strips between the outer wall and the two thicknesses of 1/4-inch rubber matting. The inner box is made of 7/8-inch, well-seasoned, tongue-and-groove oak fitted closely against the insulating matting. No nail, rivet, or bolt extends through the rubber insulation.

The floor of the outer box is secured to the chassis by two sets of bolts through an intermediate piece of well-seasoned oak. One set of bolts is countersunk from the top of the intermediate piece of oak, and the other set is countersunk from the bottom. The countersunk portions are filled with "insulate," an insulating compound. Adjacent bolts are at least 6 inches apart.

The bed of the inner box is divided into six compartments by transverse strips of wood at the bottom and partitions near the roof. Each compartment accommodates three 50-pound cases of explosives. This arrangement prevents cases in adjacent compartments from touching, so that there is no possibility of end thrust of the entire load of explosives. Each inner compartment is 21 inches high, 58 inches long, and 16 1/4 inches wide. Separating strips at the floor are 3 inches wide and 1 1/4 inches thick. The outside dimensions of the 50-pound cases of explosives used are 17 1/2 inches long, 13 1/2 inches wide, and 12 1/2 inches high.

Access to the compartments is by two slide doors insulated on the inside. Both doors open on the clearance side, that is, the side opposite the trolley wire. The roof lumber is impregnated with 6 quarts of linseed oil, and the roof is reinforced with four tie rods. The wood is primed and painted with fire-resistant paint. The car weighs about 4,000 pounds.

The car has no bumpers, so that no one will be tempted to ride on the end. Standard, semiautomatic couplings are used, as no insulated couplings are provided in this mine.

EXPLOSIVES CAR B

Car B (fig. 2) consists of a wooden, steel-reinforced body and an inner box, mounted on a standard mine-car truck having a wheel base of 32 inches and a track gage of 42 inches. The outer box is 8 feet long and 4 feet 6 inches wide. The bottom planks are 3 inches thick and the side planks 2 inches thick. The bottom and side planks are held together by three iron straps 5/8 inch thick and 3 inches wide. One is placed at each end of the car and one in the center. The ends are secured by two 5/8- by 2 1/2-inch vertical iron straps and one 1/2- by 2 1/2-inch iron strap placed horizontally near the top of the endpiece. The endpieces are not assembled until the inner box is in place. A false bottom, on the same level as the offset on the side, is supported by 2- by 6-inch filler blocks.

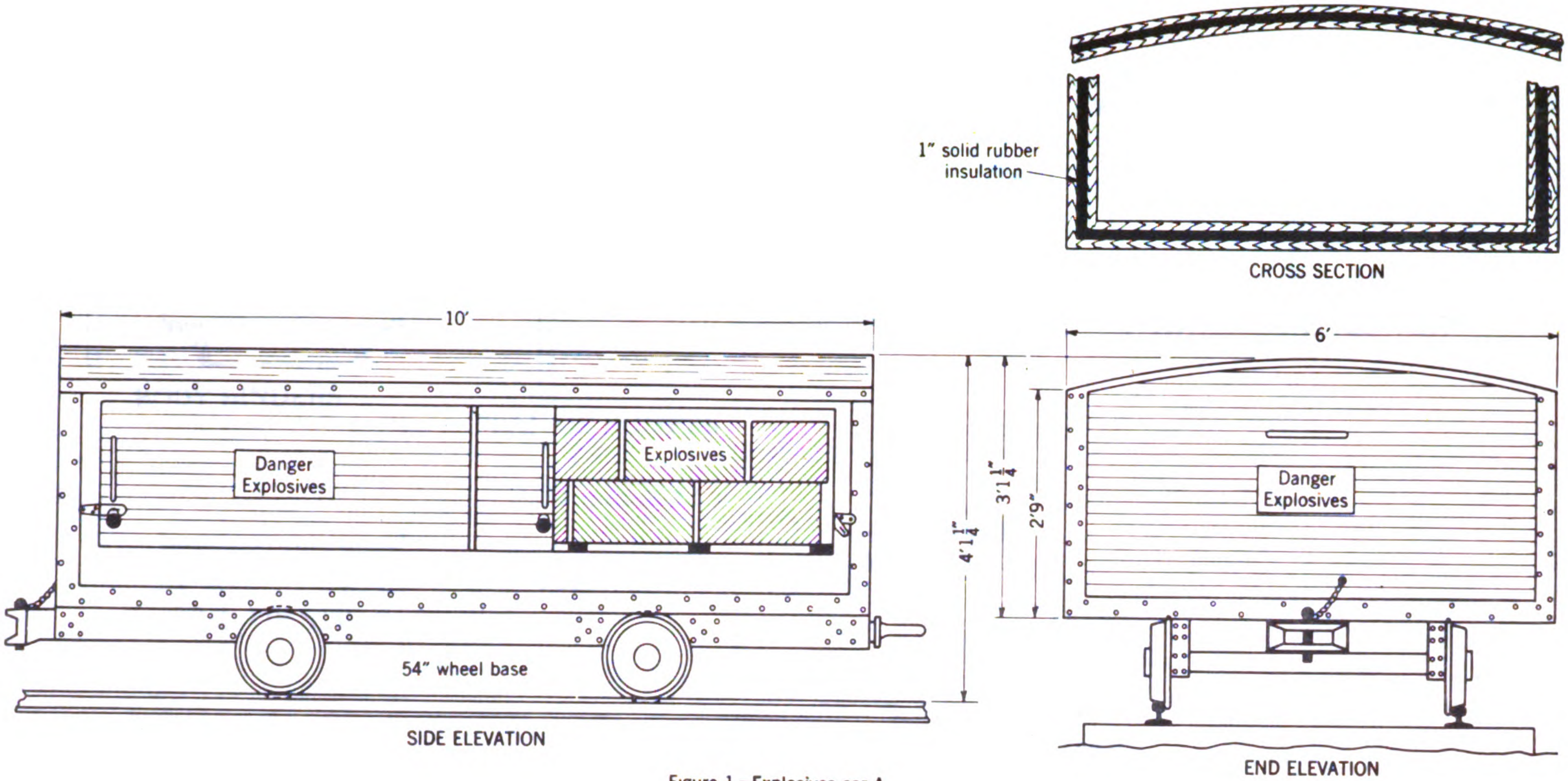


Figure 1.–Explosives car A.

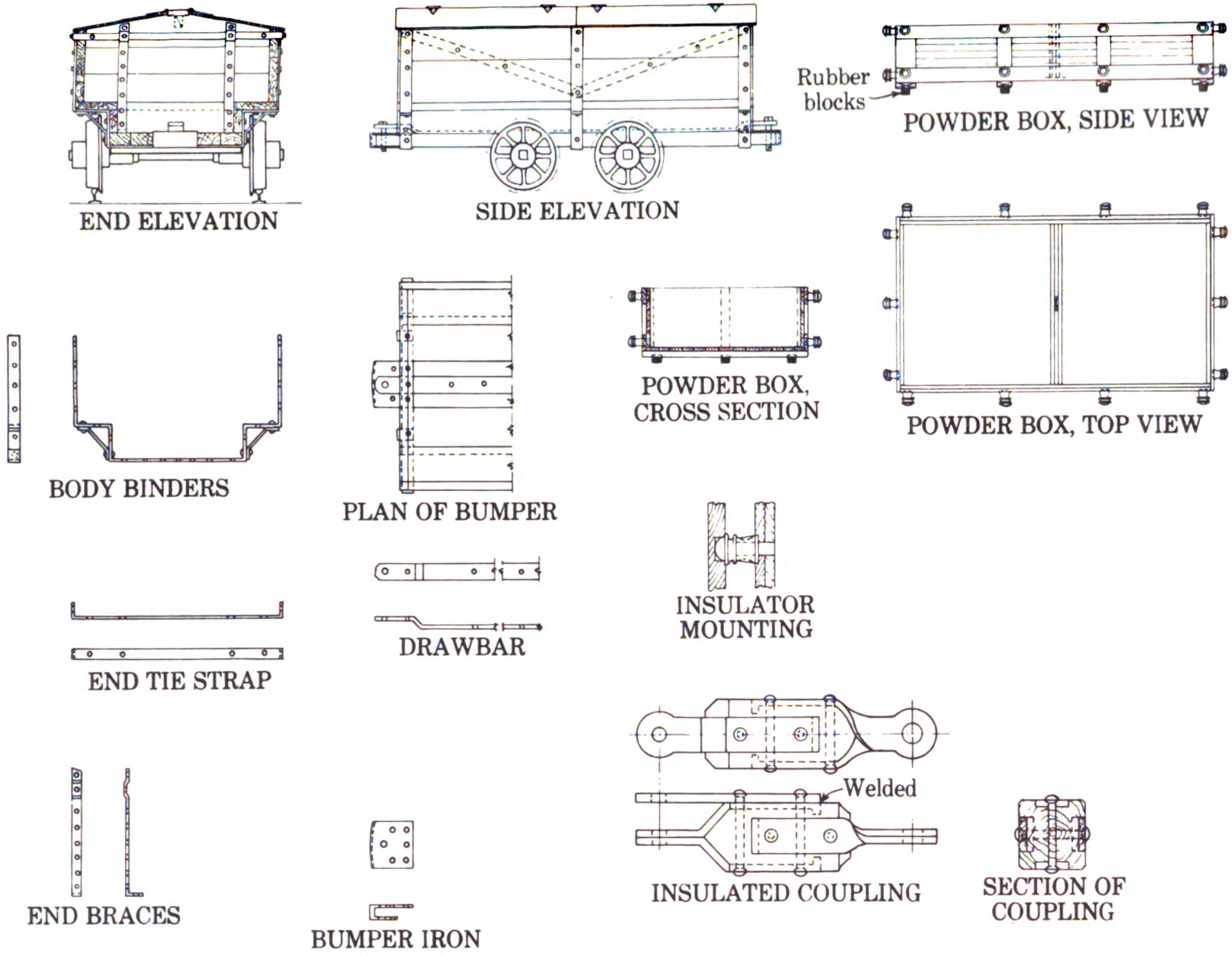
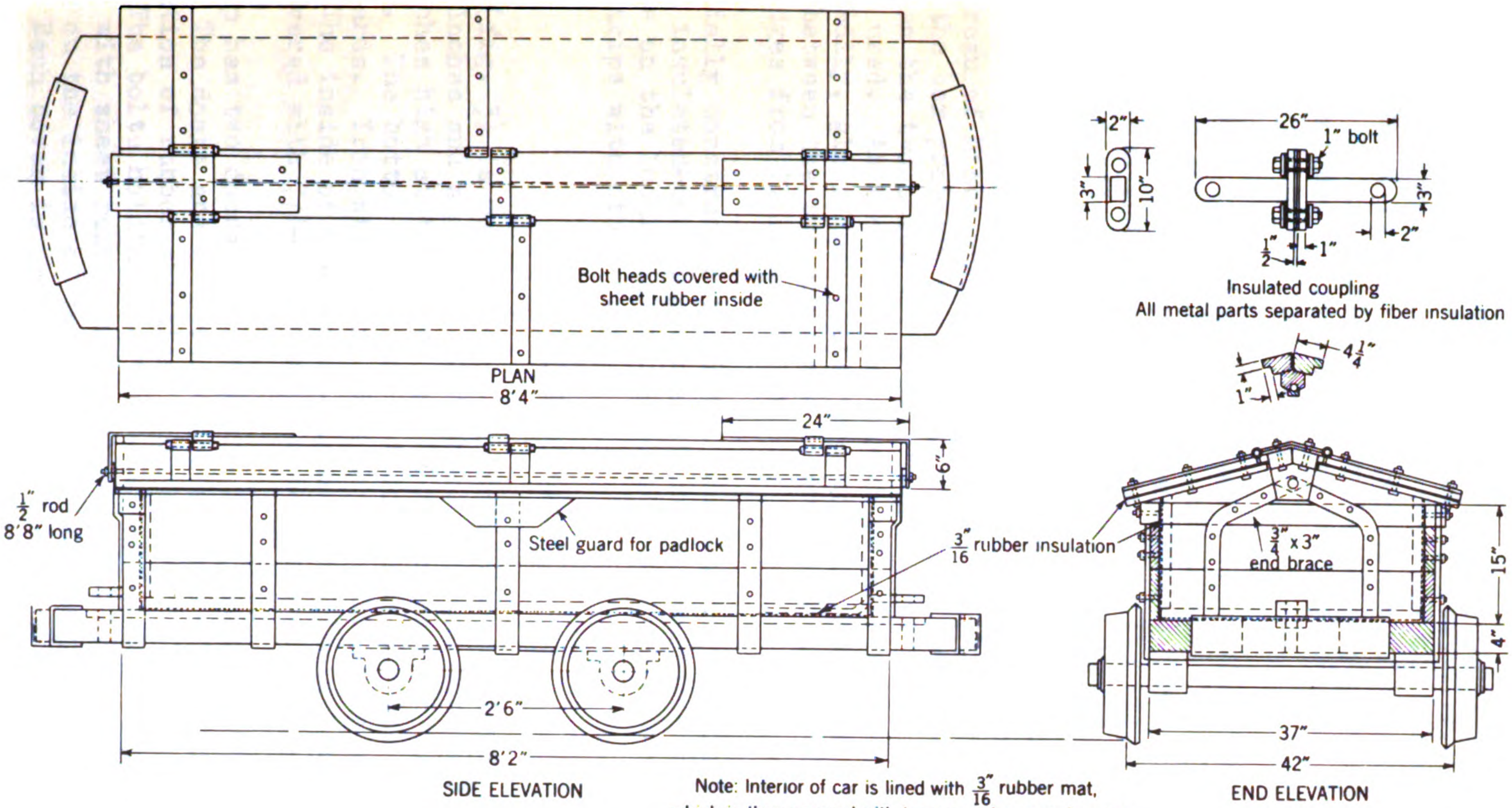


Figure 2.–Explosive car B.



Note: Interior of car is lined with $\frac{3}{16}$″ rubber mat, which is then covered with tongue and groove flooring

Figure 3.–Explosives car C.

The top of the box comprises four doors of 7/8-inch shiplap on tongue-and-groove flooring. Cleats are placed on the inside. The doors are covered with 28-gage galvanized iron. Originally the iron door and the other iron parts of the car were electrically grounded, but when it was pointed out that an arc probably would be created if a power wire fell on the iron cover the ground between the door and the other iron parts was eliminated. As it is hazardous to have doors that open under the trolley wire the doors on the side under power wires are kept locked at all times. The car is constructed without bumpers so that no one will be able to ride the bumpers while the car is in motion.

The inner box is approximately 7 feet 7 1/4 inches long, 4 feet 1 1/4 inches wide, and 18 inches high, outside dimensions. The inside and bottom of the box are built of 7/8-inch tongue-and-groove lumber with an outer frame of 1- by 4-inch and 1- by 6-inch pieces on the side and 2- by 6-inch and 2- by 4-inch pieces on the bottom. A double, wooden partition divides the box into two compartments. Hemingray glass insulators are used to support the sides of the box, and rubber insulators are used on the bottom of the box. The original plans called for No. 9 glass insulators, but when the Bureau of Mines suggested that rough handling in transit and weaving of the box probably would break the insulators and that the limited space between the two boxes would make replacement difficult, the rubber blocks were used. As the necessary number of rubber blocks could not be obtained readily, glass insulators were used on the sides. The top of the open space between the two boxes was covered with strips of wood to prevent cartridges from falling into it.

A specially constructed insulated coupling is used on the car. The drawbar and insulated-coupling connections are considerably smaller than those in use on the local coal cars, so that the explosives car cannot be handled in trips with other cars.

EXPLOSIVES CAR C

Car C (fig. 3) is mounted on a standard mine-car truck having a wheel base of 30 inches and a gage of 42 inches. The car box is 8 feet 2 inches long, 19 inches high at the edges and 25 inches high in the center, and 37 inches wide. The bottom is made of 4-inch boards and the sides and ends of 7/8-inch boards. Iron straps are used to hold the sides and bottom firmly together. The inside of the box is lined with 3/16-inch rubber sheeting, which is covered with 7/8-inch tongue-and-groove flooring.

The top has two doors extending the full length of the car, one on each side. The doors are constructed of a layer of 7/8-inch boards, a 3/16-inch insulation of rubber sheeting, then a ply of 7/8-inch tongue-and-groove flooring. The bolts holding the three straps for the hinges on each door are covered with sheet rubber inside the box. A 1/2-inch tie rod 8 feet 8 inches long on the inside of the box near the top gives rigidity of construction. Each cover is provided with a padlock. The side under the trolley wire should be kept locked at all times.

EXPLOSIVES CAR D

Car D (fig. 4) is a departure from the ordinary type of construction. It is built on a standard mine-car truck. Five 4-inch by 6-inch by 4-foot oak cross members form the base on which is nailed 2- by 4-inch cypress lumber. The floor is then covered with sheet asbestos 1 inch thick. The sides and ends are made of 2- by 4-inch cypress lumber toenailed in place on the outside with sixpenny nails. Crib construction is employed, that is, alternate side strips extend to the end of the box while the intermediate end strips extend to the sides. The lumber is then bolted in place in the center of the 2- by 4-inch pieces with five 5/8-inch bolts on each side of the car. The roof is covered with rubber sheeting, and the inside of the car is treated to make it moistureproof.

Wooden doors 1 foot 9 inches high and 2 feet 6 inches long, built of 2-inch cypress lumber, are placed on each side of the car and suspended on rollers riding on inclined rails so that the doors will close automatically, except when they are held open by the explosives delivery man. Placing the doors on both sides creates a hazard by permitting men to load or unload under the trolley wire. Locks are not provided, so that unauthorized persons can gain access to the car when the explosives crew is absent.

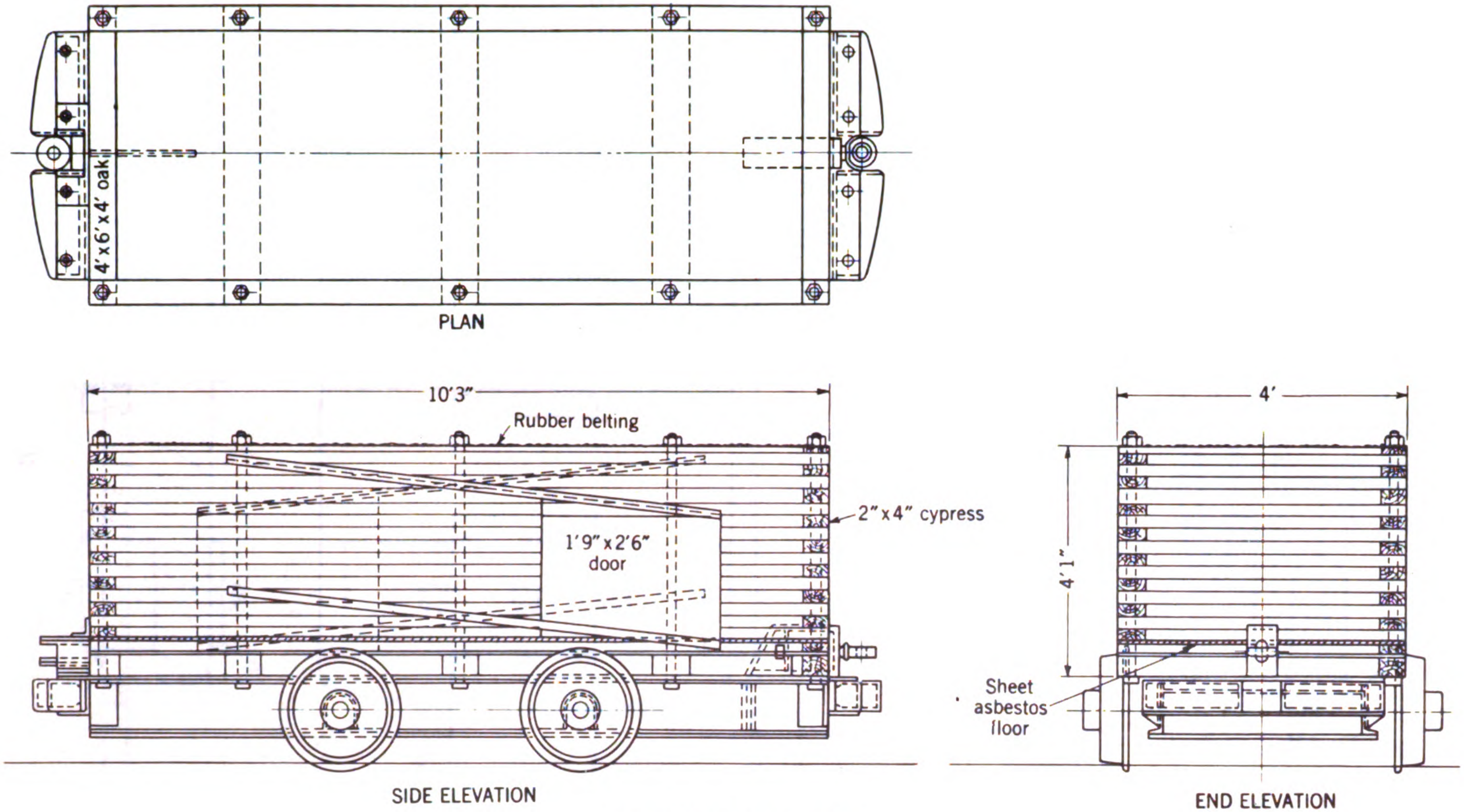
INSULATED MINE-CAR COUPLINGS

Insulated cars provide protection during the transportation of explosives; however, if possible, explosives should be hauled by mules or horse when all electricity is cut off from the mine. As animals are not used in many mines electric haulage usually is necessary. Permissible storage-battery locomotives are the safest electrical haulage equipment for explosives cars, but where they are not available the hazard from trolley locomotives is lessened by using insulated mine-car couplings. If bad bonds occur or if the locomotives run on sand on the rails, current may be shunted through the drawbars of the cars, and if the insulation in the explosives car has become defective or ineffective the explosives may be detonated or ignited. A properly designed insulated coupling will provide added protection against the entrance of electric current into explosives c

In 1928 the Bureau of Mines issued Report of Investigations 2868 entitled "Insulated Mine-Car Couplings," by F. E. Cash and C. W. Owings. The sketches of the couplings and descriptions of them are reprinted here to make this information readily available to those who may be considering the construction of cars for explosives.

Construction

The general principles of construction are similar in all insulated couplings. The piece containing the hole for the coupling pin is made of steel, and the steel parts are separated by an insulating material such as fiber or wood. The coupling is either rigid or semirigid to prevent the bumpers of the mine cars from coming in contact and to keep the cars insulated from one another at all times.



PLAN

SIDE ELEVATION

END ELEVATION

Figure 4.–Explosives car D.

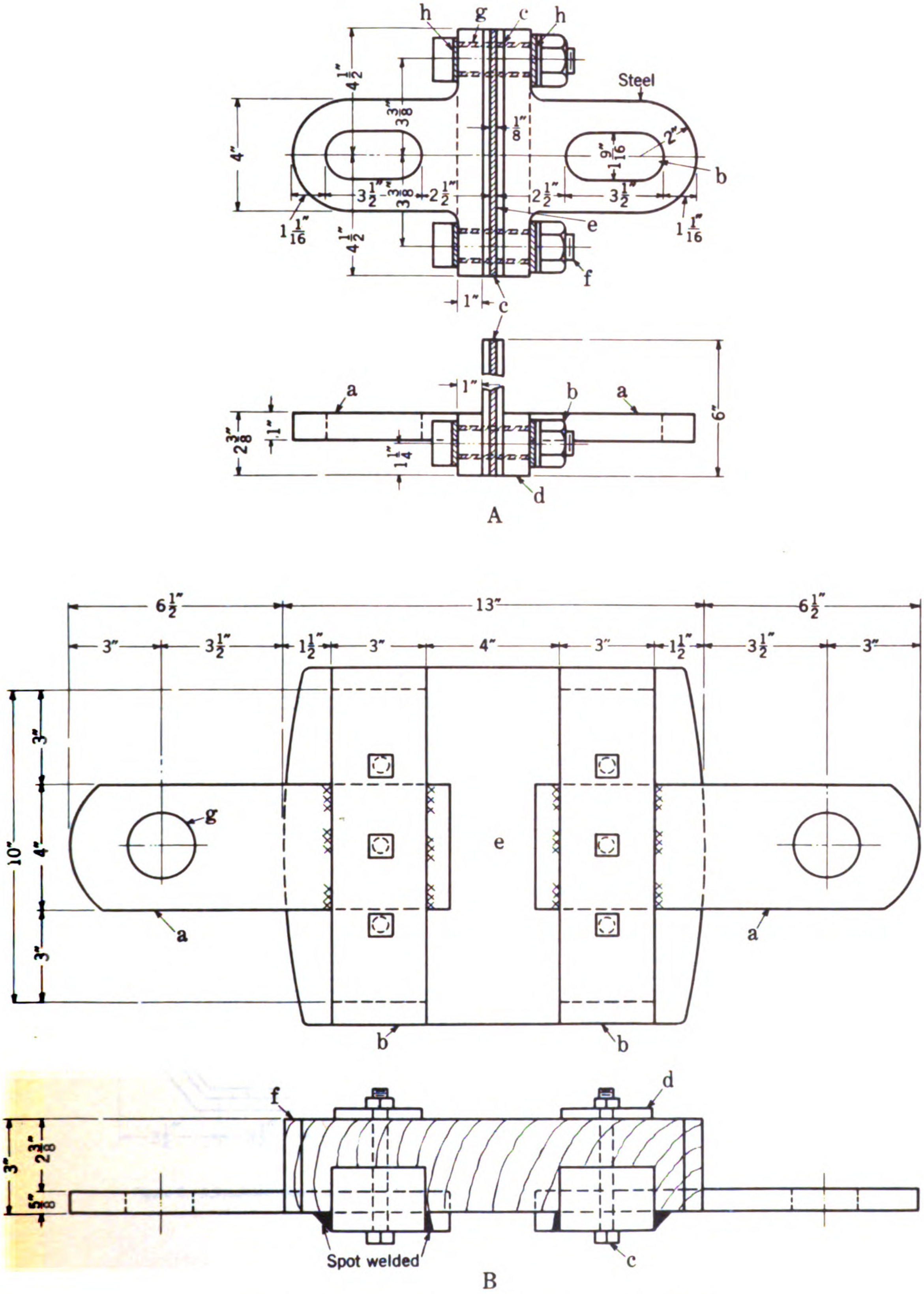


Figure 5.—A, Fiber-insulated coupling; B, wood-insulated coupling.

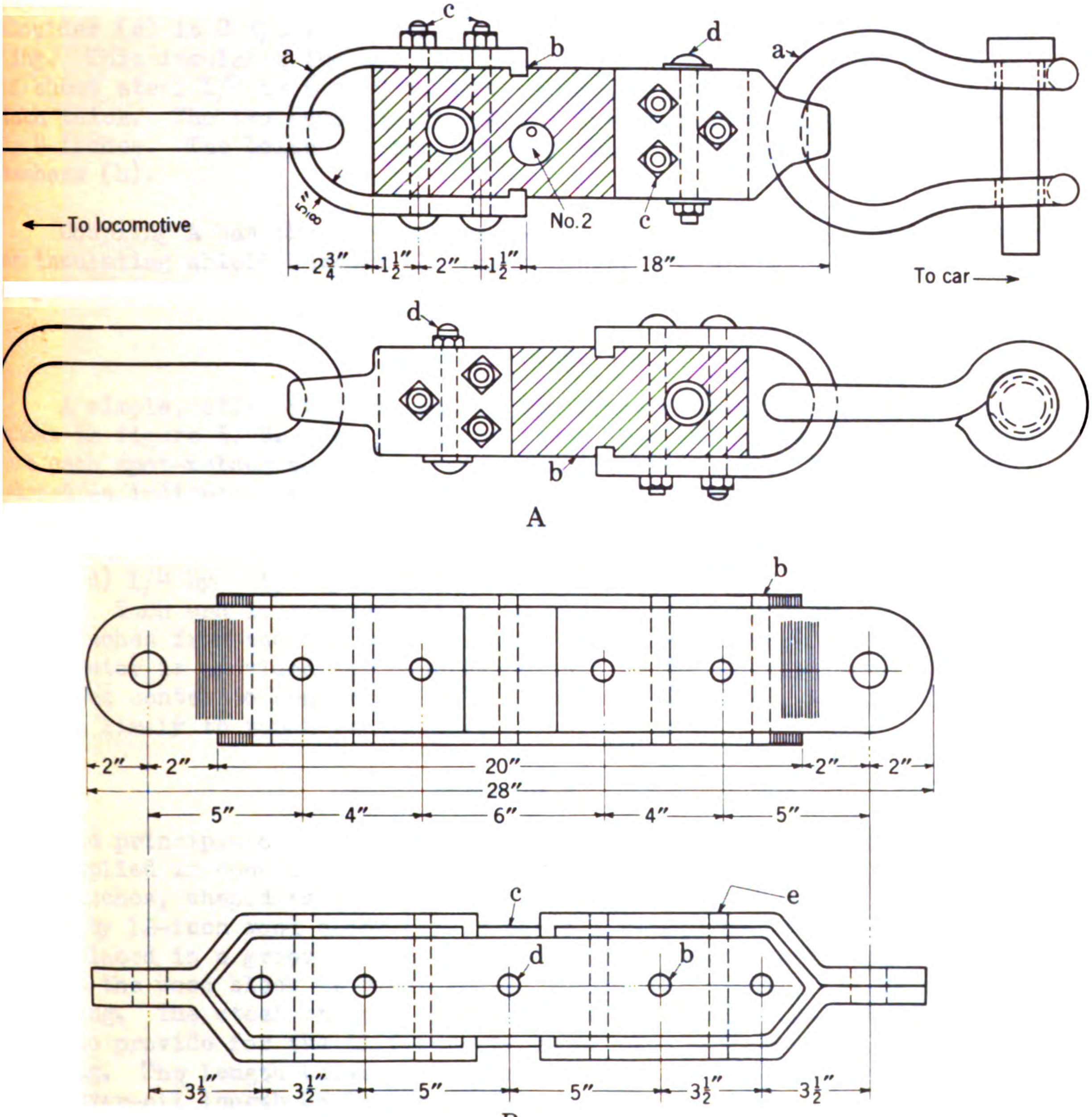


Figure 6.–A, Insulated man-trip and powder-car coupling; B, insulated coupling used in Alabama.

Coupling A

Details of an insulated coupling used in Alabama and Pennsylvania are given in figure 5, A. Two pieces of 1-inch steel (a), each containing a coupling-pin slot (b) 3 1/2 by 1 9/16 inches, are separated by a steel and fiber plate (c) 5/8 by 6 by 9 inches. The plate is so inserted that the top edge is flush with the top of the shoulder (d) of the coupling, and as the shoulder (d) is 2 3/8 inches the plate extends 3 5/8 inches below the coupling. This insulates the car bumpers. The plate (c) comprises two pieces of sheet steel 1/4 by 6 by 9 inches, separated by a piece of fiber (e) 1/8 inch thick. The two coupling pieces (a) are connected by two bolts (f) 1 by 4 inches. The bolts are insulated by fiber bushings (g) and fiber washers (h).

Coupling A has the double advantage of being insulated and providing an insulating shield between the car bumpers. This coupling can be used only on cars having one-piece rounded bumpers.

Coupling B

A simple, effective, and easily constructed insulated coupling is shown in figure 5, B. Two pieces of strap iron (a) 5/8 by 4 by 12 inches are each spot-welded to a piece of strap iron (b) 5/8 by 3 by 12 inches, shaped as indicated, and the ends are placed in a groove in the wood block. Each assembled piece is fastened to a block of wood by three bolts (c) 1/2 by 5 inches. The bolts pass through the wood block (e) and through a steel strip (d) 1/4 by 2 1/2 by 9 inches. The wood block (e) is 3 by 10 by 11 3/4 inches. Each end is rounded and faced with a 5/8-inch strip of steel. Three inches from the end of each steel strap (a) a hole (g) 1 7/8 inches in diameter is provided for coupling pins. As the coupling-pin holes are 20 inches center to center and as the coupling is rigid, the car bumpers are not likely to touch each other.

Coupling C

The principle of using a wood block as insulation in coupling B is also applied in coupling C, figure 6, A. Two pieces of steel (a) 5/8 by 3 3/4 inches, shaped as shown, are fastened to the ends of a 3 3/4- by 3 3/4- by 12-inch wood block (b) by three 1/2-inch bolts (c), the ends being placed in a groove in the wood block. A fourth bolt (d) is put through the wood block at right angles to the three bolts (c) to prevent splitting. The steel straps (a) are bolted on at right angles to each other to provide for the different types of clevis at each end of the coupling. The length between link and clevis is 18 inches, and the approximate over-all length 28 inches.

Coupling D

A modification of coupling C is shown in figure 6,B. Two built-up steel section (a) 5/8 by 4 inches, shaped as shown, are bolted with 5/8-inch bolts (b) to a wood block (c) 4 by 4 by 20 inches. The ends of the two strips are bent and inserted in the wood block. Five bolts (d) with suitable washers are inserted through the block to stiffen it. The edges of the plate are 1/2 inch from all edges of the wood blocks. Bolts (e), also 5/8 inch, are used to hold these plates.

CONCLUSIONS

The Bureau of Mines recommends and the laws of many mining States require that detonators and explosives should not be transported in the sam car or even be carried together by an employee. Explosives of different types should not be carried in the same box or car, as one type might ignite or explode more readily than the other type.

Cars for explosives should comprise two boxes so constructed that they are insulated adequately from electric current. The inner box shoul have no metal projecting on the inside and should have compartments to prevent the receptacles from moving appreciably when the car is moved. Doors should not be placed on the trolley-wire side, as this will increase the contact hazard for the explosives crew. The cars should have no bumpers, so that no one can ride on the ends of the cars.

Insulated mine-car couplings should be used to prevent ignition or detonation of the explosives when the cars are hauled by electric locomotives. At least two empty cars should be placed between the locomotive and the explosives car to reduce the danger of passage of current from th locomotive into the car.

Some mining companies using permissible explosives and electric detonators have constructed cars with a compartment designed for transporting detonators in the same car with explosives. Many sound arguments have been advanced in favor of this arrangement, but it is still believed that, in the interest of safety, only explosives of one type should be transported in a container or car.